RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Robotics and Artificial Intelligence, III Semester

Branch- Common to All Discipline

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BT301	Mathematics-III	3L-1T-0P	4 Credits

OBJECTIVES: The objective of this course is to fulfill the needs of engineers to understand applications of Numerical Analysis, Transform Calculus and Statistical techniques in order to acquire mathematical knowledge and to solving wide range of practical problems appearing in different sections of science and engineering. More precisely, the objectives are:

- ➤ To introduce effective mathematical tools for the Numerical Solutions algebraic and transcendental equations.
- ➤ To enable young technocrats to acquire mathematical knowledge to understand Laplace transformation, Inverse Laplace transformation and Fourier Transform which are used in various branches of engineering.
- ➤ To acquaint the student with mathematical tools available in Statistics needed in various field of science and engineering.

Unit I: Numerical Methods – 1: (8 hours): Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

Unit II: Numerical Methods – 2: (6 hours): Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Solution of Simultaneous Linear Algebraic Equations by Gauss's Elimination, Gauss's Jordan, Crout's methods, Jacobi's, Gauss-Seidal, and Relaxation method.,

Unit III: Numerical Methods – 3: (10 hours): Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. RungeKutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution two dimensional Laplace equation and Poission equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

Unit IV: Transform Calculus: (8 hours): Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace Transform method, Fourier transforms.

Unit V: Concept of Probability: (8 hours): Probability Mass function, Probability Density Function, Discrete Distribution: Binomial, Poisson's, Continuous Distribution: Normal Distribution, Exponential Distribution.

Textbooks/References:

1. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2ndEdition, Reprint 2012.
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
3. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2010.
6. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003(Reprint).
8. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
9. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.Statistics

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

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Robotics and Artificial Intelligence, III Semester

RA 302 - Strength of Materials

Course Objectives:

To familiarize the students with the fundamentals of deformation, stresses, strains in structural elements.

Course Outcomes: At the completion of this course, students will be able to

1. Differentiate different types of stress and strain.

2. Understand the importance of elastic constants in design of any engineering components

3. Analyze the beam of different cross sections for shear force, bending moment, slope and deflection.

4. Understand the concepts necessary to design the structural elements and pressure vessels.

5. Apply different theories of failures in designing of structural or machine components

Unit-I Simple Stress and Strain

Concept of Elastic body, stress and Strain, stress strain diagram, Hooke's law, Various types of stress and strains, Elastic constants, Stresses in compound bars, composite and tapering bars, Temperature stresses. strain energy under axial loads and stresses due to impact of falling weights.

Complex Stress and Strains- Two dimensional and three-dimensional stress system. Normal and tangential stresses, Principal Planes, Principal Stresses and Strains, Mohr's circle of stresses.

Unit-II Bending and Shearing Stresses

Bending: Theory of simple bending, Concept of pure bending and bending stress, Equation of bending, Neutral axis, Section-Modulus, Determination of bending stresses in simply supported, Cantilever and Overhanging beams subjected to point load and uniformly distributed loading, Bending stress distribution across a section of beam, strain energy in bending.

Shearing Stress: Shearing Stress in a beam and shear stress distribution across a section in Beams.

Unit III Slopes and Deflection

Differential equation of the elastic curve, Determination of Slope and Deflection of beams by Double Integration Method, Macaulay's Method, Area Moment Method, and Strain Energy Method.

Unit IV Torsion of Shafts and Theories of Failure

Concept of pure torsion, Torsion equation, Determination of shear stress and angle of twist of shafts of circular section, Torsion of solid and hollow circular shafts, Analyses of problems based on combined Bending and Torsion, Theories of Failure

Unit V Columns & Struts, Thin Shells

Columns & struts: Theory of columns, Slenderness ratio, Direct and bending stresses in short columns, Stability of structures, Euler's formula for columns with different end conditions, Rankine's formula, Eccentric loads and the Secant formula, Imperfections in columns

Thin Pressure Vessels: Cylinders and spheres. Stress due to internal pressure, Change in diameter andvolume.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

References:

1. Beer FP, Johnson Mechanics of Materials ,Sixth Edition ;Mc Graw Hills
2.   Debabrata Nag & Abhijet Chanda :Strength of Materials : Wiley
3. Rajput R.K.; Strength of Materials, S.Chand Publications,New Delhi
4.   Rattan; Strength of materials;Second Edition , Mc Graw Hills
5.   Nash William; Schaum's Outline Series; forth Edition Strength of Materials;Mc Graw Hills
6. Singh Arbind K; Mechanics of Solids; PHI
7. Khurmi R.S.; Strength of Materials. S.Chand
8. Sadhu Singh; Strength of Materials; Khanna Pub.
9.   R Subramannian , Strength of materials OXFORD University Press ,Third Edition .
10.   S Ramamurthum , Strength of materials , Dhanpat Rai

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Robotics and Artificial Intelligence, III Semester

RA 303 – Data Structure

Course Objectives:

1. To assess how the choice of data structures and algorithm design methods impacts the performance of programs.

2. To develop logics which will help them to create programs, applications in C.

3. To learn how to design a graphical user interface (GUI) with Java Swing.

Expected Course Outcome:

1. Clear knowledge about problem solving skills in DS & Algorithms concepts

Syllabus:

Unit I: Data Structures: Trees. Concepts of Data and Information, Classification of Data structures, Abstract Data Types, Implementation aspects: Memory representation. Data structures operations and its cost estimation. Introduction to linear data structures- Arrays, Linked List: Representation of linked list in memory, different implementation of linked list. Circular linked list, doubly linked list, etc. Application of linked list: polynomial manipulation using linked list, etc.

Unit II: Stacks: Stacks as ADT, Different implementation of stack, multiple stacks. Application of Stack: Conversion of infix to postfix notation using stack, evaluation of postfix expression, Recursion. Queues: Queues as ADT, Different implementation of queue, Circular queue, Concept of Dqueue and Priority Queue, Queue simulation, Application of queues.

Unit III : Tree: Definitions - Height, depth, order, degree etc. Binary Search Tree - Operations, Traversal, Search. AVL Tree, Heap, Applications and comparison of various types of tree; Introduction to forest, multi-way Tree, B tree, B+ tree, B* tree and red-black tree.

Unit IV: Graphs: Introduction, Classification of graph: Directed and Undirected graphs, etc, Representation, Graph Traversal: Depth First Search (DFS), Breadth First Search (BFS), Graph algorithm: Minimum Spanning Tree (MST)- Kruskal, Prim's algorithms. Dijkstra's shortest path algorithm; Comparison between different graph algorithms. Application of graphs.

Unit V: Sorting: Introduction, Sort methods like: Bubble Sort, Quick sort. Selection sort, Heap sort, Insertion sort, Shell sort, Merge sort and Radix sort; comparison of various sorting techniques. Searching: Basic Search Techniques: Sequential search, Binary search, Comparison of search methods. Hashing & Indexing. Case Study: Application of various data structures in operating system, DBMS etc.

EVALUATION Evaluation will be continuous an integral part of the class as well through external assessment.

Text Books

1. AM Tanenbaum, Y Langsam& MJ Augustein, "Data structure using C and C++", Prentice Hall India.

2. Robert Kruse, Bruse Leung, "Data structures & Program Design in C", Pearson Education. Reference Books

 1. Aho, Hopcroft, Ullman, "Data Structures and Algorithms", Pearson Education.

2. N. Wirth, "Algorithms + Data Structure = Programs", Prentice Hall.

3. Jean – Paul Trembly , Paul Sorenson, "An Introduction to Structure with application", TMH.

4. Richard, Gilberg Behrouz, Forouzan ,"Data structure – A Pseudocode Approach with C", Thomson press.

5. Data Structures using C & C++, As per AICTE by Rajesh Shukla Wiley publication

Suggested List of Experiments:

1. Write a program that uses functions to perform the following operations on singly linked list i)Creation ii) Insertion iii) Deletion iv) Traversal.
2. Write a program that uses functions to perform the following operations on doubly linked list i)Creation ii) Insertion iii) Deletion iv) Traversal.
 3. Write a program that uses functions to perform the following operations on circular linked List i)Creation ii) Insertion iii) Deletion iv) Traversal.
4. Write a program that implement stack (its operations) using i) Arrays ii) Linked list(Pointers).
5. Write a program that implement Queue (its operations) using i) Arrays ii) Linked list(Pointers).
6. i) Write a program that implement Circular Queue using arrays. ii) Write a program that uses bothrecursive and non recursive functions to perform the following searching operations for a Key valuein a given list of integers: a) Linear search b) Binary search.
7. Write a program that implements the following sorting i) Bubble sort ii) Selection sort iii)Quicksort.
8. Write a program that implements the following i) Insertion sort ii) Merge sort iii)Heap sort.
 9. Write a program to implement all the functions of a dictionary (ADT) using Linked List.
10. Write a program to perform the following operations: a) Insert an element into a binary searchtree. b) Delete an element from a binary search tree. c) Search for a key element in a binary searchtree.
11. Write a program to implement the tree traversal methods
12. Write a program to perform the following operations: a) Insert an element into a AVL tree. b)Delete an element from a AVL tree. c) Search for a key element in a AVL tree.

Course Outcomes:

After studying this course, students will be able to;

1. Differentiate inversions of different types of kinematic chains, and also to draw velocity and acceleration diagram
2. Perform static & dynamic force analysis of four link mechanism and slider crank mechanism
3. Design flywheel used to avoid fluctuation of energy
4. Understand theory of effect of gyroscopic couple on the stability of Aeroplanes, Ships& automobiles
5. Trace Cam Profile, understand methods of balancing of reciprocating and rotating masses as well as different modes of power transmission systems particularly through gears.

Unit I: Introduction: Kinematics and kinetics, mechanisms and machines, degree of freedom, types of motions, concept of kinematic links, basic terminology and definitions, Different types of joints, Kinematic pairs and kinematicchains, inversions, absolute and relative motions, displacement, velocity and acceleration diagrams, different mechanisms and applications,

Unit II: Static & Dynamic Force Analysis : Static equilibrium of two/three force members, Static equilibrium of member with two forces and torque, Static force analysis of linkages, D'Alembert's principle, Equivalent offset inertia force, Dynamic force analysis of four link mechanism and slider crank mechanism, Dynamically equivalent system.

Turning Moment & Flywheel Engine force analysis-Piston and crank effort, Turning moment on crankshaft, Turning moment diagrams-single cylinder double acting steam engine, four stroke IC engine and multi-cylinder steam engine, Fluctuation of energy, Flywheel and its design

Unit III:
Gyroscopic Motion: Principles, Gyroscopic torque, Effect of gyroscopic couple on the stability of aeroplanes, ships& automobiles

Cams: Introduction, classifications of cams and followers, nomenclature, analysis of cam and follower motion, analytical cam design with specific contours, pressure angle, radius and undercutting, motion constrains and program, critical path motion, torque on cam shaft

Unit IV:
Balancing of Machines: Static and dynamic balancing, Balancing of several masses rotating in the same plane and different planes, Balancing of primary and secondary forces in reciprocating engine, Partial balancing of two-cylinder locomotives, Variation of tractive force, swaying couple, hammer blow, Balancing of two cylinder in-line engines.

Unit V: Power transmission: kinematics of belt- pulley, flat and v –belt, rope, condition of maximum power transmission, efficiency, friction, friction devices, pivot and collars, power screw, plate and cone clutch, brakes, classifications, bock, band, internal and external, frictioncircle, friction axis,
Gears: laws of gearing, classification and basic terminology, tooth profiles, kinematic considerations, types of gears, spur, bevel, worm, helical, hypoid etc, gear trains, epicyclic, compound, Introduction to vibration, single degree of freedom.

REFERENCE BOOKS:

1. R. L. Norton, kinematics& dynamics of machinery, Tata McGraw Hill, ISBN13 978 0 07014480 4
2. A. Ghosh & A. Malik, Theory of Mechanisms and Machines, EWP Pvt Ltd, ISB 81 85095 72 8
3. R.S.Khurmi, A text book of Theory of Machines,S Chand
4. S.S.Ratan,Theory of Machines,TMH
5. P.L. Balani, Thory of Machines and Mechanisms, Khanna Publishers
6. Thomas Beven ,Theory of Machines and Mechanisms

Tutorials:

1Displacement diagrams of slider crank and other linkages, analytical and graphical
2. Velocity diagrams and acceleration diagrams of Four bar chain and single slider crank mechanism
3. Diagrams of cam and followers for different applications
4. Gears and gear trains transmission diagrams, analytical and graphical applications
5. Balancing of reciprocating and rotary masses
6. Gyroscopic effects on aero planes, navel ships and automotives
7. Solutions to problems of industrial application using software
8. Determination of braking Torque in different types of Brakes

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RA 305 – Electronic Devices and Circuit

Syllabus

Unit I: Semiconductor Devices

Theory of P-N junction: Temperature dependence, breakdown characteristics, and junction capacitances. Diodes: Zener diode, varactor diode, PIN diode, LED, and photodiode. Transistors: BJT, FET, and MOSFET - types, working principles, characteristics, regions of operation, load line biasing method. Transistor as an amplifier: Gain, bandwidth, frequency response, h-parameters equivalent, types of amplifiers

Unit II: Feedback Amplifiers and Oscillators

Feedback amplifier: Negative feedback, voltage-series, voltage-shunt, current-series, and current- shunt feedback. Sinusoidal oscillators: L-C (Hartley-Colpitts) oscillators, RC phase-shift, Wien bridge, and crystal oscillators. Power amplifiers: Class A, class B, class AB, class C amplifiers - efficiency and power dissipation

Unit III: Operational Amplifiers and Applications

Operational amplifier characteristics: Slew rate, full power bandwidth, offset voltage, bias current. Amplifier configurations: Inverting amplifier, non-inverting amplifier, summing amplifier, differentiator, integrator. Differential amplifier: Calculation of differential and common-mode gain, CMRR. Darlington pair, log and antilog amplifier, voltage-to-current and current-to-voltage converters, comparators, Schmitt trigger, active filters

Unit IV: Integrated Circuits and Sensors

555 timer and its applications. Multivibrators: Bistable, monostable, and astable multivibrators. ICs and sensors: Study of different sensors such as temperature (LM35), infrared sensors, motor drive (L293D), Humidity and Temperature Sensor (DHT22), 3-Axis Magnetometer (LIS3MDL), Light Sensor (BH1750), Temperature and Humidity Sensor (SHT31)

Unit V: Power Supplies and Regulators

Regulated power supplies: Series and shunt regulators, current limiting circuits. Introduction to IC voltage regulators: Fixed and adjustable regulators. Switching regulators: SMPS, UPS

References: -
1. Milliman Hallkias - Integrated Electronics; TMH Pub.
2. Gayakwad; OP-amp and linear Integrated Circuits; Pearson Education
3. Electronics Device and circuits By S Salivahanan and N Suresh Kumar ; McGraw Hill Publication; Second Edition
4. Electronic Devices and Circuits, 2ed by Anil Maini Wiley Publication
5. Electronics Device and Circuits By Jacob Milman, Christos C. Halkias, Chetan D. Parikh; Tata Macgraw Hill Publication
6. Basic Electronics devices and Circuits By Mahesh B Patil ; PHI Learning PVT. Ltd.
7. Electronic Devices & Circuit Theory By Boylestad ; PHI
8. Salivahanan; Linear Integrated Circuits; TMH-
9. Miliman Grabel; Micro electronics , TMH
10. RobertBoylestad & Nashetsky; Electronics Devices and circuit Theory; Pearson Ed.

List of Experiments (Expandable):

1. Diode and Transistor characteristics
2. Transistor Applications (Amplifier and switching)
3. OP-Amp and its Applications
4. 555 timer and its Applications

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RA 306 – Electronics Workshop

Proposed list of Experiments:

- PCB making process and soldering and desoldering, Creating circuits on zero PCB.

- Simple Transistor based circuits.

- Interfacing of various sensors like Infrared Sensor, Ultrasonic Sensor, Temperature Sensor, Humidity Sensor, moisture sensors, etc.

- Interfacing different types of motors like, DC Motor, Stepper Motor, Servo Motor withArduino. Different types of Motor Driving ICs, L293D, ULN2003, etc.

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